CH302 Worksheet 12. Balancing Redox reactions and assigning cell convention.

Use the **table of standard reduction potentials** below as required.

Half reaction	E°	Half reaction	E°
$Li^+ + e^- = Li$	-3.04	$Sn^{+4} + 2e^- = Sn^{+2}$	+0.15
$Na^+ + e^- = Na$	-2.71	$Cu^{+2} + e^- = Cu^+$	+0.16
$Mg^{+2} + 2e^- = Mg$	-2.38	$Cu^{+2} + 2e^- = Cu$	+0.34
$Al^{+3} + 3e^- = Al$	-1.66	$I_2 + 2e^- = 2I^-$	+0.54
$2H_2O + 2e^- = H_2(g) + 2OH^-$	-0.83	$Fe^{+3} + e^- = Fe^{+2}$	+0.77
$Zn^{+2} + 2e^- = Zn$	-0.76	$Ag^+ + e^- = Ag$	+0.80
$Cr^{+3} + 3e^- = Cr$	-0.74	$Hg^{+2} + 2e^- = Hg$	+0.85
$Fe^{+2} + 2e^- = Fe$	-0.41	$NO3^- + 4H^+ + 3e^- = NO + 2H_2O$	+0.96
$Cd^{+2} + 2e^- = Cd$	-0.40	$Br_2 + 2e^- = 2Br^-$	+1.07
$Ni^{+2} + 2e^- = Ni$	-0.23	$O_2 + 4H^+ + 4e^- = 2H_2O$	+1.23
$Sn^{+2} + 2e^- = Sn$	-0.14	$Cr_2O_7^{-2} + 14H^+ + 6e^- = 2Cr^{+3} + 7H_2O$	+1.33
$Pb^{+2} + 2e^- = Pb$	-0.13	$Cl_2 + 2e^- = 2Cl^-$	+1.36
$Fe^{+3} + 3e^- = Fe$	-0.04	$MnO_4^{-2} + 8H^+ + 5e^- = Mn^{+2} + 4H_2O$	+1.49
$2H^+ + e^- = H_2$	0.00	$F_2 + 2e^- = 2F^-$	+2.87

15 reactions to use in answering the questions below.

Dr. Laude's demos (balance by inspection)

1. $H_2 + O_2 \rightarrow H_2O$
2. $Na + H_2O \rightarrow Na^+ + OH^- + H_2$
3. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

Simple redox reactions (use change of oxidation method)

4. $Cu + Zn^{++} \rightarrow Zn + Cu^{++}$
5. $Al + Fe^{+3} \rightarrow Al^{+3} + Fe^{+2}$
6. $Pb + Cr^{+3} \rightarrow Pb^{+2} + Cr$
7. $Li + F_2 \rightarrow Li^+ + F^-$

Acid (use change of oxidation method in acid)

8. $Mn^{+2} + I_2 \rightarrow MnO_4^- + I^-$
9. $BrO_3^- + N_2H_4 \rightarrow$ Br- $+ N_2$
10. $Fe^{+3} + H_2O \rightarrow O_2 + Fe^{+2}$
11. $P_4 + NO_3^- \rightarrow H_2PO_4^- + NO$
12. $Cr_2O_7^{-2} + Sn^{+2} \rightarrow Cr^{+3} + Sn^{+4}$

Base (use change of oxidation method in base)

13. $CN^- + MnO_4^- \rightarrow MnO_2 + CNO^-$
14. $Fe(OH)_2 + O_2 \rightarrow Fe(OH)_3$
15. $C_2H_5OH + MnO_4^- \rightarrow C_2H_3O_2^- + MnO_2$

Part I. Balance all of the electrochemical (redox) reactions above. Refer to Worksheet 11a for assistance in how to perform the "change of oxidation method" approach. For those who are more comfortable with the "half reaction method", feel free to use that. It yields the same result—it just wastes a lot of time.

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

Part II. Standard Cell Potential. Assuming standard conditions, calculate the standard cell potential for reactions: 2, 4, 5, 6, 7, 8, 10 and 12 for the reaction as written, using the equation $E^{o}cell = E^{o}_{cathode} - E^{o}_{anode}$

Reaction: **Cell** **Potential**

2

4

5

6

7

8

10

12

Part III. Cell convention. For reactions 2, 4, 5, 6, 7, 8, 10 and 12 as written above, find the following for the electrochemical cell assuming the reaction is as written:

reaction	voltaic or electrolytic	Half reaction at + electrode	Half reaction at - electrode
2			
4			
5			
6			
7			
8			
10			
12			

Part IV. Cell shorthand notation. No one likes to draw all those beakers and wires in an electrochemical cell (except people who like to draw), so electrochemists have developed shorthand electrochemical notation. Use it to draw the electrochemical cells of reactions 2, 4, 5, 6, 7, 8, 10 and 12.

Reaction: **Cell** **Shorthand**

2

4

5

6

7

8

10

12